**Goal**
To create a device that measures VO2max, heart rate and outputs calories burned.

**Why build this project?**
As interest in personal health continues to grow throughout the world, so does the need for more effective exercise routines and equipment that advance, measure and record growth. The motivation behind this project is to mobilize and bring the benefits of a physical fitness laboratory to this growing audience. Currently there are no products alike this that exist on public market. Anything comparable to this product is extravagant in cost and forces the user to remain static either on a treadmill or bike.

**Approach**

- To calculate calories burned we use the following information:
  - 5.05 Kcal burned per Liter of Oxygen.
  - 4.73 Kcal burned per liter of CO2.
- Anemometer is used to calculate wind velocity.
- It is attached on the right side of the mask where an air valve allows air to flow in.
- To calculate air in take; take the measured wind velocity and multiply it by the area of the tube and the length of the breath.
- CO2 sensor measures the parts per million of CO2 that is exhaled.
- It is attached on the left side of the mask where an air valve allows air to exit the system.
- In combination with the anemometer we are able to calculate VO2max.
- The pulse sensor was engineered by our group.
  - An IR LED shines through a finger or an earlobe.
  - With every heartbeat, blood collects and thickens within the veins; as a result, less light passes through.
  - The photodiode senses these changes and produces a voltage which is then sent through the filter and amplifier.
- Two RF wireless transceivers are used for high levels of mobility.
  - Two Arduino Uno's.
  - One is attached to the mask which collects all the readings from the sensors.
  - The other one is connected to the computer so that it can send data to Matlab.
- Matlab is used to analyze and calculate data.
- GUI is used to display data in a neat and user friendly fashion.

**System Design Overview**

- **Anemometer**
- **CO2 Sensor**
- **RF Transmitter**
- **Pulse Sensor**
- **Base Station:** Arduino/Computer

**Pulse Sensor Design**

- **Filter Design**

**Sensor Data**

<table>
<thead>
<tr>
<th>CO2 Output Samples Taken</th>
<th>Air Volume Intake Samples Taken</th>
<th>Pulse Sensor Samples Taken</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>14</td>
<td>0.2</td>
<td>0</td>
</tr>
<tr>
<td>15</td>
<td>0.4</td>
<td>0</td>
</tr>
<tr>
<td>16</td>
<td>0.6</td>
<td>0.8</td>
</tr>
<tr>
<td>17</td>
<td>0.8</td>
<td>1</td>
</tr>
<tr>
<td>18</td>
<td>1</td>
<td>1.2 x 10^-4</td>
</tr>
<tr>
<td>19</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>2.2</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>2.4</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>2.6</td>
<td></td>
</tr>
</tbody>
</table>

*Samples are taken 5 times a second*